Saskatchewan Research Council
Annual Report 1988 - 89

SRC
Saskatchewan
Research Council

Table of Contents

Letter of Transmittal 2
Board of Directors 3
Chairman's and President's Messages 4
Energy and Minerals Branch
Biomass Resources Program 6
Mineral Resources Program 8
Engineering Services Program 10
Petroleum Division 11
Environment and Resources Branch
Sedimentary Resources 13
Remote Sensing Program 15
Atmospheric Processes Program 16
Aquatic Biology Program 18
Terrestrial Ecology and Archaeology Program 20
Technology Transfer and Business Development Branch
Innovation Division 22
Canadian Centre for Advanced Instrumentation 23
Precision Instruments Group 23
Electronics Group 23
Technology Services Division 24
Product and Process Development Division 25
Administration and Finance Branch
Analytical Services Laboratory 27
Bovine Blood Typing Laboratory 28
Financial Statements 29

Corporate Profile

The Saskatchewan Research Council (SRC) is the Province of Saskatchewan's principal research and development organization.

Established in 1947, SRC furthers the economic development and diversification of Saskatchewan by providing a range of applied scientific, engineering, and technical services. Currently, over two hundred scientists, engineers, technicians, and support staff deliver these services to the resource, manufacturing, agriculture, and business sectors of Saskatchewan.

SRC is a member of the Association of Provincial Research Organizations (APRO).

Hon. Richard Swenson

LETTER OF TRANSMITTAL

February 1990
To the Honourable Sylvia Fedoruk
Lieutenant Governor of Saskatchewan

May it please your Honour:

The undersigned presents herewith, for your consideration, the report of the Saskatchewan Research Council for the year ended March 31, 1989.

Respectfully submitted,

Richard Swenson
Minister Responsible for the Saskatchewan Research Council

THE RESEARCH COUNCIL ACT

Section 21, in part, directs that:

The Council shall on or before the last day of February in each year submit to the Lieutenant Governor in Council a report of its proceedings and transactions during the next preceding calendar year, which report shall contain such particulars as the Lieutenant Governor in Council may prescribe. Every report shall be laid before the Legislative Assembly if then in session, or if it is not in session, within fifteen days after the opening of the next session.

SASKATCHEWAN RESEARCH COUNCIL
BOARD OF DIRECTORS (as of March 31, 1989)

Gordon C. Birney
Chairman, SRC
Partner, Birney & Smith
Chartered Accountants
Saskatoon

Jim Hutch
Secretary, SRC
President, SRC
Saskatoon

Hon. Ray Meiklejohn
Minister Responsible for SRC
Regina

Harley D. Olsen
Deputy Minister, Saskatchewan
Science and Technology
Saskatoon

Curtis F. Kunkel
President
ALTO Construction Services Ltd.
Esterhazy

W.L. (Bill) Whelan
Manager, Saskatchewan Division
Canadian Petroleum Association
Regina

Peter N. Nikiforuk
Dean, College of Engineering
University of Saskatchewan
Saskatoon

Cam Blachford
Associate Vice President & Dean
Faculty of Graduate
Studies & Research
University of Regina
Regina

Marcel de la Gorgendiere
Chairman of Saskatchewan
Securities Commission
Saskatoon

Oscar Hanson
President
SaskEnergy Corporation
Regina

Carol Teichrob
Moonvale Farms
Saskatoon

Sharon Stevenson
Saskatoon

Diana S. Rak
Marketing Manager
Peat Marwick Consulting Group
Saskatoon

John Cross
President
Philom Bios Inc.
Saskatoon

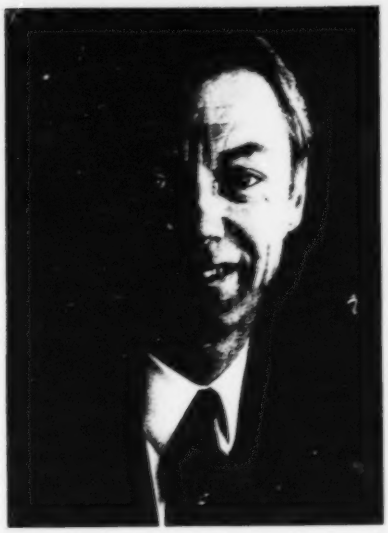
J.G. (Jack) Manns
Associate Vice President
(Research) & Dean, College of
Graduate Studies & Research
University of Saskatchewan
Saskatoon

John Nightingale
President
Key Lake Mining Corporation
Saskatoon

Gavin Semple
President & General Manager
Brandt Industries Ltd.
Regina

Ross McQuarrie
Manager - Production
Northern Telecom Canada Ltd.
Saskatoon

Chairman's Report



Gordon Birney,
Chairman of the Board of Directors

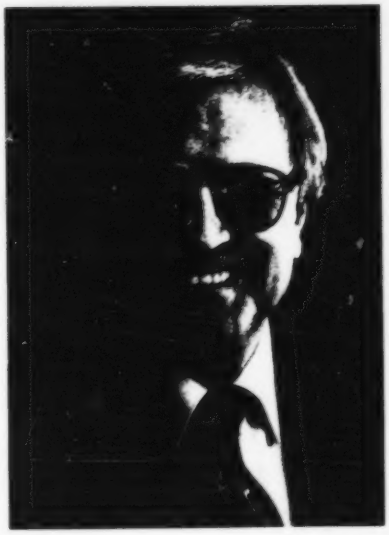
With a population of slightly more than one million people, Saskatchewan enjoys a very diversified and balanced economy. The segments of that economy include agriculture (farming and agricultural product processing), mineral resource development (potash, uranium, gold, copper, zinc, lead, coal, and initial exploration for diamonds), oil and natural gas exploration and refining, pulp and paper, lumber, fishing, steel production, manufacture of small farm implements and other products, hydro development, and there are more. There is diversification.

The province faces the nineties with forecasts for economic improvement which will evolve from the future development and growth of the economic segments. The opportunities are enormous.

To attempt to describe the nature and extent of the future development of the products and services encompassing the various sectors of the province's economy would be difficult at this time. But, it is a certainty that a major component and catalyst in the province's future development will be research, and the application of that research.

President's Message

Staff: Betty Gilroy



Jim Hutch
President

Technology and innovation are major contributors to economic growth. Although it is conventional wisdom now, this fact was recognized by Saskatchewan policy makers over forty years ago when they established the Saskatchewan Research Council with a mandate to apply science and technology for Saskatchewan's development.

SRC uses three approaches in its work:

The first is development of technologies which are uniquely required by Saskatchewan. Examples of this include the work of our Petroleum Research Unit, work in the areas of geology, groundwater, agricultural input costs containment and water quality issues, to name only a few.

A second approach provides state-of-the-art laboratory and other services which would otherwise not exist in Saskatchewan. These include our analytical chemistry laboratory, geochemistry laboratory services and the Bovine Blood Typing Laboratory.

The third approach is technology needs assessment, technology transfer and technology adaptation. Here, we identify specific technology needs of Saskatchewan and facilitate the process of technology adoption and adaption for use by Saskatchewan. Our objective is to reduce the time it takes to adopt technology because early adoption means competitive advantage as contrasted with late adoption which results in a continuous catch-up scenario.

SRC's work is carried out by interdisciplinary teams of engineers and scientists. These teams include people from other organizations that are part of our network, both nationally and internationally.

Although continuing to be at the forefront of technology during the last decade, we have made the transition to an

The SRC is poised to provide the necessary research and development services as an integral part of the province's future growth pattern, and to share the opportunities which will prevail.

The strategic plan for the SRC is being regularly monitored, and changed where necessary, to maintain their position as being current in meeting the needs of their clients in the specified areas of research and development.

With the introduction of a second oil upgrader refinery in Lloydminster, the petroleum division of SRC is maintaining its research programs relating to heavy oil to enhance the recovery of oil from reservoirs. The SRC is also providing services relating to the exploration of the kimberlite pipes near Sturgeon Lake in Saskatchewan as potential diamond bearing sources.

Environment and Economy Conferences are being held throughout Canada, in the United States, and indeed, throughout the world. The "environment" is now a global concern. More resources are being identified by governments and corporations in order to address the multiple problems associated with the "environment" which require immediate attention, and action.

The strategic plan for the SRC identifies the matter of the "environment" as one of prime importance. Several departments within the SRC are currently conducting projects involved with matters concerning the "environment". They include air, land and water sampling and quality, waste management, farm management, and others.

The SRC has enjoyed another successful year in attaining a high degree of excellence in the performance of its many projects. I am proud of the achievements of SRC, and their contributions to economic and scientific development within the province. That pride is also shared by the members of the Board of Directors.

I wish to express my appreciation of the support of the Board of Directors. And, on behalf of the Board and myself, I wish to acknowledge the excellent leadership of Jim Hutch as President, and the dedication to excellence of the people at SRC.

Gordon Birney

organization which is driven by the needs of our clients. As we develop and apply these new technologies, we become agents for change both internally and through our services to our clients.

SRC's success requires the collaborative efforts of our Government, the Board of Directors, and the people of SRC. During the past year, our Board articulated a "Saskatchewan sensitive" direction for SRC. It requires us to be sensitive to all sectors of the Saskatchewan economy. It also means continuing to blend the needs of economic development and diversification with environmental protection and quality of life.

The challenge is to live up to our vision - to be a business-like market oriented organization that blends applied research and development with a commercial approach to carrying out the mission. This is achievable as long as we focus on the client and understand their complex needs. The needs are complex because the industrial model is changing; global trade and market forces, redrawn trading borders, technological advances, realization of resource limitations and environmental concerns all have an impact on our clients' economic well being.

Technology is global and moves around the world at electronic speed. Our network of national and international technology partners help clients match needs with appropriate technologies - and the means to access these.

Our business is technology but our strength is our people - interdisciplinary teams of dedicated professionals whose expertise and attitudes provide the clients with assurance that their needs will be met. This credibility results in quality based relationships built on trust and integrity.

Because people are our strength, one primary objective is to provide human resource programs and a performance management system that create an atmosphere conducive to achievement, and a compensation system designed to reward that achievement.

With the support of the Government, the Board of Directors, and through the dedication of our staff, we have completed the year in a good financial position despite massive changes in federal government funding programs, uncertainty of markets, and a difficult year for our primary industries - agriculture and resources.

Thanks are due to all of our partners in the Saskatchewan community - whose mutual goals are economic growth and diversification, the development of human potential, security and stabilization of the rural community, and fiscal responsibility.

For their support we thank our clients, industry, the provincial government and its departments, agencies and Crowns as well as the federal government.

I also thank Gordon Birney, Chairman and our Board of Directors who provide valuable support through their dedication to Saskatchewan and SRC in providing me and my team with leadership, direction, guidance, and support.

The people of SRC, our clients and our Government are positioned to address the issues of the next decade with confidence.

Jim Hutch

ENERGY AND MINERALS BRANCH

Vice President: Earl St. Denis, Ph.D., P.Eng.
Staff: Denise Schergevitch

SRC biochemistry technologist Betty Swerhone analyses chaff samples for fermentable sugars, as part of the studies on industrial and feed applications of chaff.

BIOMASS RESOURCES PROGRAM

Manager: Ewen Coxworth, Ph.D.

Increasing and improving the use of forages, selected seed crops and crop residues continued to be the focus of the Biomass Resources program.

Addressing the problems of productivity of marginal land, the Biomass Resources Program continued its development work with forage crop varieties. An investigation of varieties that are both drought resistant and saline tolerant revealed that kochia has the potential to double hay yields on at least fifty thousand acres of marginal land in Saskatchewan.

Work continued with naturally occurring herbicides. Young canola and mustard plants were identified as allelopathics to broad leaf weeds. Further research in this area could lead to substantial savings in weed control costs and serve as an effective method of soil conservation for Saskatchewan farmers.

Seeking to make the most efficient use of crops and crop byproducts, the Biomass Resources Program has developed new processing methods for crop residues, forages and oil seeds. This has resulted in feeds, food, fuel, fiber and feedstocks that productively utilize raw materials and could contribute to effective cost management and energy conservation in the agricultural sector.

Highlights

- Developed a new production process for ethanol.
- Studied cost/benefit results on chaff collection systems finding that chaff removal may reduce tillage operations, and can reduce herbicide requirements over a period of years.
- Completed a cost/benefit study of enzyme treatment for canola seed resulting in a cost reduction in processing, while improving the quality of oil and meal.
- Completed a cooperative research project with Agriculture Canada and the University of Saskatchewan that proved kochia is safe to use as a feed supplement for cattle. This produced savings estimated between $5 and $9 million for Saskatchewan cattlemen during the 1988-89 winter season.
- Cooperative research with Alberta Agriculture studied the agronomy and feed use of kochia.
- Discovered the use of mustard and canola as effective weed control. By killing young canola and mustard plants, a combination of natural herbicides, competition and shading achieved 99 percent control of green foxtail and kochia, and 94 percent of wild oats in field trials and growth room.
- Initiated patent action for a project relating to production of industrial chemicals from agricultural and forestry raw materials.

Staff
W. Craig (Ph.D.)
M. Gimby (Dip.Agr.)
J. Kernan (M.Sc.)
P. Kullman
A. Mair (Bio.Sci.Tech.)
A. Rutherford (M.Sc.)
K. Sosulski (Ph.D.)
E. Swerhone (Bio.Sci.Tech.)

Publications

Energy Efficiency and Energy Supplies for a Sustainable World. *Coxworth, E.* R-810-1-E-89 (1989)

Drought Proofing Cattle Feed Supplies with Kochia: March 1989 Progress Report. *Coxworth, E. Kernan, J. Green, D. Steppuhn, H.* R-814-1-E-89 (1989)

The Nutritional Value of Awned and Non-Awned Wheat Chaffs and Their Responses to Ammoniation. *Kernan, J. Knipfel, J. Crowle, W. Coxworth, E. Mair, A.* R-814-2-E-89 (1989)

Prairie Pothole Influence on Saline Soil Location. *Rutherford, A.* R-812-8-D-88 (1988)

Preliminary Project to Determine How Ammonia Treatment Affects the Viability of Weed Seeds in Screenings and the Feed Value of the Screenings. *Kernan, J. Knipfel, J. Mair, A.* R-814-7-E-88 (1988)

Comparison of Locally Available Sources of Nutritional Supplements and Mineral Additives as Growth Promoters for Mycelium of Shiitake Mushrooms. *Sosulski, K.* R-816-6-E-88 (1988)

Evaluation of the Efficiency of Seed Pressing and Oil Bleaching of Enzyme Treated Canola: Progress Report. *Sosulski, K. Sosulski, F.* R-816-10-E-88 (1988)

Preliminary Experiments on Determining the Allelopathic Effects of Some Brassica Species on Kochia Growth. *Mair, A. Coxworth, E.* R-817-2-E-88 (1988)

Natural Herbicides and Plant Growth Regulants in Canola and Sweetclover Residues: Progress Report 1988. *Coxworth, E. Foster, K. Austen, H.* R-817-3-E-88 (1988)

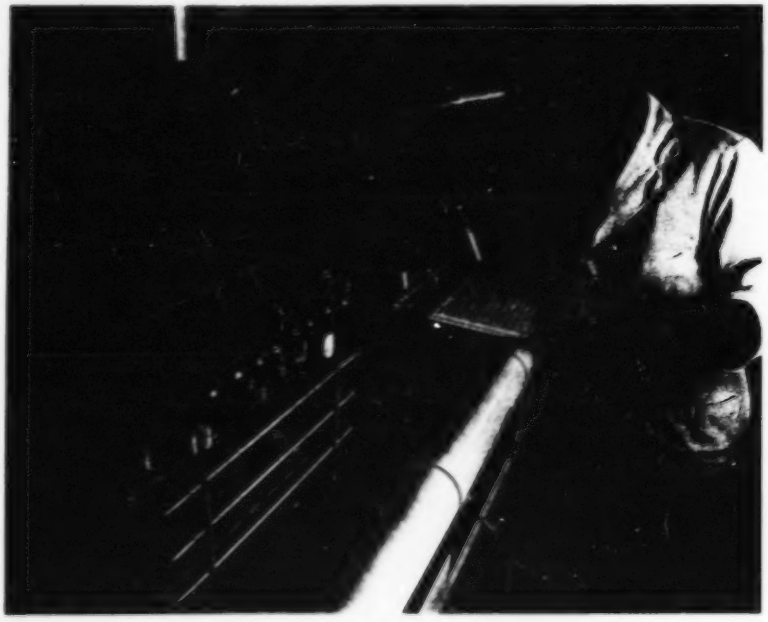
A Vision of Sustainable Development in a Rural Environment. *Coxworth, E.* R-810-1-D-88 (1988)

Energy and Economic Savings Realized by Collection and Utilization of Chaff. *Kernan, J. Coxworth, E. Rutherford, A. Gimby, M.* R-811-5-D-88 (1988)

Cropping Strategy Cash Flow Analyzer: Use to Compare Low Input Traditional Cropping Systems and High Input Soil Saver Systems: Task 2B Farm Enerdemo. *Bens, R.* R-812-5-B-88 (1988)

Farm Enerdemo Presentations at the Agricultural Institute of Canada National Conference, 1988, Calgary, Alberta. *Coxworth, E.* R-812-7-E-88 (1988)

In field trials at the Kernen Farm, researchers simulated the effects of shading by a cover crop (green manure crop) on the suppression of the growth of weeds, such as foxtail.



SRC scientist Krystyna Sosulski is determining enzyme activity in mushroom substrate. The mushroom's unique capacity to release enzymes externally may present opportunities for the recovery of enzymes and their application in the pulp and paper industry. The use of enzymes as a biological process could replace the chemical processes currently used within the industry.

Specializing in economic geology, geochemistry and mineralogy, Dave Quirt uses a microscope with a heating stage when examining fluid inclusions in carbonate minerals to establish temperature and pressure conditions of formation. This process is used to establish criteria for determining the origin of mineral deposits.

MINERAL RESOURCES PROGRAM

Manager: Michel Mellinger, Doc.Spec., M.A.Sc., P.Eng.

The Mineral Resources Program, which includes the Geochemical Laboratory, the Mineralogical Laboratory and the Mineral Processing Pilot Plant, provided applied research, technical and analytical services to Saskatchewan's mining industry.

Mineral exploration firms made use of the program's advanced image analysis system. The system integrates data from various surveys into specialized maps and new sophisticated data modelling techniques to assess resource development opportunities in the province. New techniques were developed for the uranium exploration that allow investigation of deposits one thousand feet below grade.

The Geochemical Laboratory analyzed over forty thousand samples for the mining industry. The laboratory also provided expanded services in the following areas: fire assay analysis for precious metals, heavy mineral separation analysis, and platinum-palladium analytical techniques. Analytical capabilities were expanded in response to increased activity in uranium and gold exploration, and expertise was developed to service companies now exploring for diamonds.

Using specific gravity measurement and state-of-the-art x-ray equipment, the Mineralogical Laboratory analyzed and processed over three thousand samples for mineral identification.

Practical problems about the processing of minerals were solved in the Mineral Processing Pilot Plant. Working under contract, the pilot plant conducted bench scale and pilot projects for the mining industry concerning mineral extraction, treatment of mine effluents and the further processing of mine tailings to extract secondary products.

Highlights

- Completed the first year of study on the complex geology of Archean and Aphebian rocks underlying uranium deposits in the Athabasca Basin; now seeking targets up to 1,000 metres deep.
- Clarified the geological process for the formation of the Eagle Point uranium deposit and defined exploration criteria for deposits in similar geological settings.
- Assessed data from a lake sediment geochemical survey in the eastern part of the Athabasca Basin that indicated the potential of uranium deposits.
- Developed innovative data filtering and modelling techniques to complete a large digitizing and map production project.

Geochemical Laboratory

Expanded and upgraded analytical capabilities in response to increased activity in uranium and gold exploration.

Extended services and geological expertise to include the diamond exploration industry. Analyzed approximately four thousand till samples for heavy minerals and gold grains; fifteen thousand samples for gold fire assay; and thirty thousand other samples, averaging about fifteen determinations per sample.

Staff

I. Annesley (M.Sc.)
P. Archibald (B.A.)
R. Banman
B. Bell
R. Brule
S. Cutts
J. Dyck (Ph.D., P.Eng.)
J. France (M.A.)
B. Gartner
A. Holsten (B.Sc.)
A. Jackson
C. McClelland
R. McKnight (B.A., C.E.T.)
D. Quirt (M.A.Sc.)
J.W.J. Smith (B.Sc.)
L. Turple

Mineralogical Laboratory

Analyzed approximately twenty-five hundred samples for clay minerals and two hundred and fifty samples for specific gravity measurement.

Mineral Processing Pilot Plant

Conducted bench scale and small pilot plant studies for uranium and gold projects as a subcontractor to mineral processing consultants.

Publications

Integrating Mineral Exploration Surveys by Use of Image Analysis: The Carswell Structure (Saskatchewan, Canada). *Leymarie, P. Mellinger, M. Laine, R. Dardel, J.* R-851-3-A-88 (1988)

Pt, Pd and Au Data From Samples of Host Rocks of Saskatchewan Uranium Deposits. *Quirt, D.* R-855-6-E-88 (1988)

Multivariate Patterns of Field Information and Geochemistry in a Regional Lake Sediment Survey: The NEA/IAEA Athabasca Test Area Revisited. *Mellinger, M.* R-851-1-D-89 (1989)

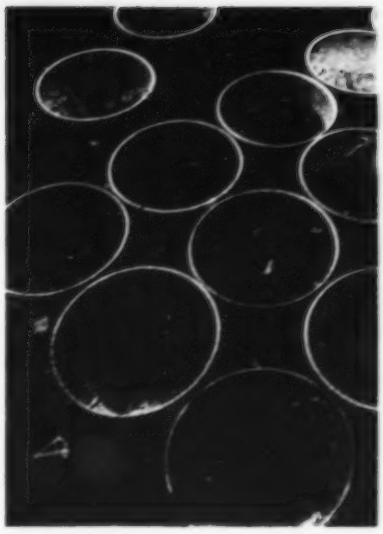
Host-Alteration at Eagle Point South. *Quirt, D.* R-855-1-E-89 (1989)

A Re-examination of the Wollaston Group and Its Underlying Archean Basement in Northern Saskatchewan. *Annesley, I.* R-855-2-A-89 (1989)

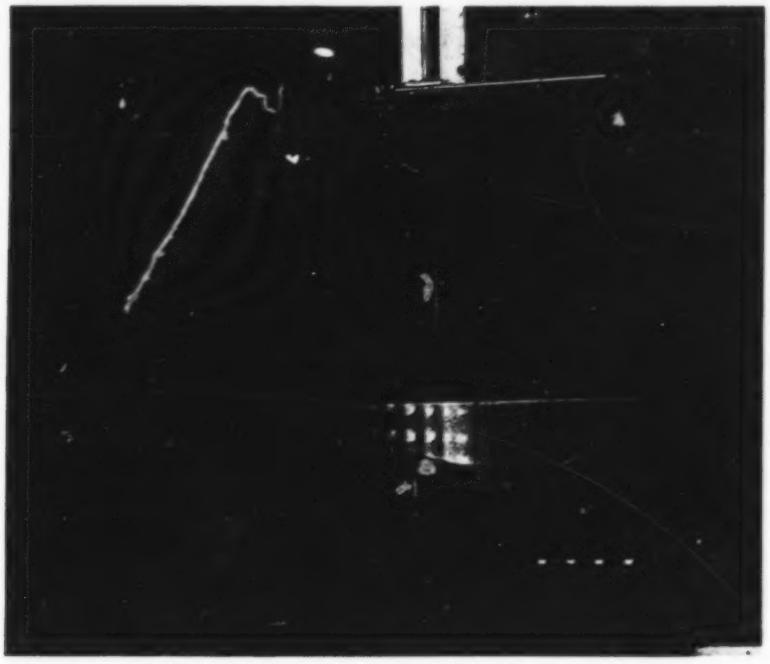
Activities in Data Analysis and Image Analysis at the Saskatchewan Research Council. *Mellinger, M.* R-851-4-A-88 (1988)

Data Analysis at SRC: From Data Collection to Decision-Making. A Short Seminar. *Mellinger, M.* R-851-5-D-88 (1988)

The Multivariate Chemical Space, and the Integration of the Chemical, Geographical, and Geophysical Spaces. *Mellinger, M.*, et al R-851-6-D-88 (1988)



Powdered rock samples are weighed into crucibles and mixed with tungsten metals and iron chip before being put into the induction furnace to determine carbon and sulphur content. Crucibles are refractory ceramic pots which can withstand temperatures of over 1500 °C.



A variety of processes are used to provide accurate analysis of ores and mining operations samples. Using lead-button fire assaying, research technologist Ron Banman removes crucibles containing gold samples fused with flux from a furnace heated to 1050 °C.

Engine expert Jim Davies tests the performance of a dual-fuel tractor in the product testing laboratory. This tractor was adapted to operate on either diesel fuel or a fifty per cent combination of diesel fuel and compressed natural gas.

ENGINEERING SERVICES PROGRAM

Manager: Dave Eyre, B.Sc., C.Phys., F.Inst.P.

The Engineering Services Program provided unique services and expertise in energy technologies and building sciences. Recognized as a national Centre of Excellence, the group continued to develop and demonstrate compressed natural gas (CNG) as a cost efficient fuel for Saskatchewan farmers. Work was completed on demonstrations of ground-source heat pumps which were shown to be economically and technologically viable.

The program's engineers and technicians continued work on the development of national standards for caulks, sealants and weatherstrip products to go into effect in 1989-90.

The Solids Pipelining Centre, a world leader in this technology, continued to provide engineering data that reduced construction costs and increased operating efficiencies for the mining, coal and oil industries.

Highlights

- Demonstrations showed that up to 50% of fuel used in trucks and tractors could be substituted with CNG from on-farm CNG fuelling stations.
- A new home compressor unit showed economic potential.
- Ground source heat pumps proved to be economically and technically viable.
- Proposed new national standards for testing caulks, sealants and weatherstrip products proceeded to the final stages of enactment.
- Weatherstrip tests featured in *Canadian Consumer Magazine*, 1986, Volume 19, #2.

Pipeline Technology Centre Highlights

The Centre worked on coal transportation studies that utilized pipe-loop testing of coal in crude oil mixtures; thermally upgraded Saskatchewan tested lignite slurries; a hydraulic hoisting study which included the physical modelling of coarse-particle injection equipment; and mathematical modelling of the mineral ore slurry flows in vertical pipes.

Studied heavy crude oil emulsion pipeloop tests on the movement of produced sand in short oilfield pipelines.

Staff

J. Flynn
R. Gillies (M.Sc., P.Eng.)
S. Hill (CAD/CAM Tech.)
D. Jennings
J. Jones (I.Tech.)
J. Kalthoff
J. Lychak
P. Schergevitch
M. Small (Chem.Tech.)
M. Sulatisky (M.Sc., P.Eng.)

Publications

A Study of Retrofit on Two Basements in Saskatoon. *Eyre, D.* R-821-2-E-88 (1988)

CNG on Farms: Observations on the New Zealand Natural Gas Vehicle Conversion Industry. *Davies, J.* R-822-2-E-88 (1988)

CNG on Farms: Tractor Performance: Interim Report. *Davies, J. Sulatisky, M.* R-822-3-E-88 (1988)

Ground Source Heat Pumps for Saskatchewan Farms. *Sulatisky, M. Rooks, D. van der Kamp, G.* R-821-1-E-89 (1989)

PETROLEUM DIVISION

Director: Jim Hutchinson, M.S., P.Eng.

Petroleum Research

Manager: Ranga Ranganathan, Ph.D., P.Eng.

The Regina-based Petroleum Research staff applied research and technical services to increase the recovery and cost-effective use of Saskatchewan's petroleum resources. Special emphasis was placed on heavy oil. Enhanced oil recovery processes for heavy oil, such as steam, in-situ combustion and carbon dioxide injection, have the potential of increasing the amount of heavy oil that can be produced in Saskatchewan by $15 billion.

The laboratories combine research and pilot testing to develop improved upgrading technology, which can convert the heavy crude to a higher value and turn it into a more marketable product. The breadth of activity from the recovery to upgrading allows problems to be addressed comprehensively, and provides a basis for multiclient research projects which have attracted widespread industry support.

The Analytical Services Unit continued to serve oil companies and support petroleum research by providing chemical and physical analyses of produced petroleum fluids and petroleum products. The Division also maintained a specialized library to provide industry with up-to-date technical and scientific information.

Brian Kristoff, who specializes in horizontal wells and steam injection, and SRC technologist Perry deWit examine core material after a core flood, to determine recovery efficiency of the core.

Highlights

- Presented to industry annual updates on four multiclient projects relating to enhanced oil recovery: Heavy Oil/CO_2; Light Oil/CO_2; In-Situ Combustion; and Thermal Studies. Eleven companies were represented. A Horizontal Well Workshop, organized in cooperation with Saskatchewan Energy and Mines, was attended by thirty industry personnel. A presentation to industry on two other multiclient projects relating to production, emulsion research and sand control, was attended by representatives from eleven companies.
- Constructed a number of devices to further enhance oil recovery, including a pyrolysis reactor to study reaction kinetics of heavy oil components, a cell to measure the diffusivity of CO_2 in heavy oil, a rising bubble apparatus used to determine reservoir miscibility pressure with CO_2 and a light oil coreflood apparatus used to determine recovery efficiency under different injection strategies.
- Developed a new SARA (saturates, aromatics, resins and asphaltenes) method for a multiclient project on combustion. Novel sand characterization techniques were developed to investigate sand producing wells.
- Operated the Mobile Emulsion Treatment Unit in Battrum, Saskatchewan for a six-week period and for a two-week period in Tangleflags, Saskatchewan.

Staff

V. Barnabe
E. Chung (B.Sc.)
P. deWit (Chem.Tech.)
E. Exelby
R. Exelby (Mech.Eng.Tech.)
N. Freitag (Ph.D., P.Eng.)
N. Gaveronski
J. Giesinger
R. Hearn (Dip.Bus., C.M.A.)
E. Horn
S. Huang (Ph.D.)
D. Hymers
C. Jackson (B.Sc.)
I. Kitamura
B. Kristoff (B.Sc., P.Eng.)
L. Kurucz (Chem.Tech.)
L. Leniuk
M. Lund
F. Mourits (Ph.D.)
E. Ogu (M.Sc.)
E. Pappas (B.Sc., P.Eng.)
G. Perron (Bio.Sc.Tech.)
J. Scoular (B.Sc., P.Eng.)
N. Shatilla (Chem.Tech.)
D. Sinclair
D. Soveran (B.Sc., P.Eng.)
B. Verkoczy (Ph.D.)

MANAGEMENT ADVISORY BOARD

Steve Balog, Vice President, SASKOIL (Regina, Saskatchewan)

Bud Dahlstrom, Senior Vice President Consumers' Co-op Refineries Ltd. (Regina, Saskatchewan)

Bud McLean, Vice President, Production Murphy Oil Company Ltd. (Calgary, Alberta)

George Miller, President and Director of Research, Nova Husky Research Corporation Ltd. (Calgary, Alberta)

C.L. Murphy, Manager, Heavy Oil Mobil Oil Canada Ltd. (Calgary, Alberta)

Bob Skinner, Assistant Deputy Minister, Petroleum Energy, Mines & Resources Canada (Ottawa, Ontario)

Art Wood, Vice President, Engineering and Marketing, Norcen Energy Resources Ltd. (Calgary, Alberta)

Pat Youzwa, Assistant Deputy Minister Saskatchewan Energy and Mines (Regina, Saskatchewan)

- Installed and tested an electrostatic separator in the emulsion trailer unit and sent a scaled-up coalescer column to Murphy's Eyehill site for installation.
- Filed a modified patent application on "Fuels from Vegetable Oils." The proposal on "Engine Testing of Vegetable Oil-Derived Fuels" was approved under the federal Biomass Development Program.

Publications

Enhanced Oil Recovery by Steam Injection - Scaled Physical Model Studies. *Kristoff, B.J. Knorr, K.D.* P-110-90-E-88 (1988)

In-Situ Combustion Studies. *Freitag, N. Pappas, E. Exelby, R.* P-110-98-E-88 (1988)

Catalytic Hydrocracking of Heavy Oils in a Layered Fixed Bed. *Court, A.L. Soveran, D.W.* P-110-112-E-89 (1989)

Characterization of Heavy and Medium Oils from Saskatchewan Reservoirs. *Verkoczy, B. Jha, K.* P-110-68-D-88 (1988)

Hydroprocessing of Biomass Oils: Final Report. *Soveran, D.* P-110-75-E-88 (1988)

Behaviour of Heavy Oil Core Material Under Simulated Fireflood Conditions. *Verkoczy, B. Jha, K.* P-110-75-D-88 (1988)

Separation and Characterization of Surfactants Present in Emulsions Produced in Enhanced Oil Recovery Processes: Final Report. *Mourits, F. Shook, C.* P-110-82-E-88 (1988)

Operating Experience with SRC's Mobile Emulsion Treatment Mini-Plant. *Scoular, R. Mourits, F.* P-110-99-D-88 (1988)

Nonhydrogenative Co-Processing of Saskatchewan Heavy Oil and Coal. *Varma, R. Bakhshi, N. Ranganathan, R.* P-110-110-A-89 (1989)

Characterization and Treatment of Saskatchewan Heavy Oil Emulsions. *Mourits, F.M. Scoular, F.J. Kurucz, L.* P-110-84-C-88 (1988)

Miscible Displacement in Saskatchewan Light and Medium Oil Reservoirs. *Huang, S.* P-110-93-C-88 (1988)

Base Conditions for Determination of the Effects of Oil-in-Water Emulsifiers on In-Situ Combustion. *Freitag, N. Exelby, R.* P-110-111-C-89 (1989)

Enhanced Heavy Oil Recovery by Carbon Dioxide Injection. Year One. *Huang, S. deWit, P. Knorr, K. Shatilla, N.* P110-114-C-89 (1989)

Emulsions Research. *Mourits, F.M. Scoular, R.J. Kurucz, L. Renouf, G.* P-110-117-C-89 (1989)

Sand Control Studies. *Pappas, E.S. Richardson, S. Vigrass, L.* P-110-118-C-89 (1989)

Environment and Resources Branch

Vice President: Earl St. Denis, Ph.D., P.Eng.
John Maybank, Principal Research Scientist, Ph.D.

SEDIMENTARY RESOURCES

Manager: Bryan T. Schreiner, M.Sc., P.Eng.

The scientists and technicians of the Sedimentary Resources Program continued to develop information systems and expertise concerning Saskatchewan's geology, groundwater and aggregate resources. Quantitative and qualitative assessments were provided by mapping, monitoring, modelling and analyzing these resources.

A large proportion of Saskatchewan's rural population is dependent on groundwater as its principal water supply. Working to ensure safe and reliable water supplies, this program continued ongoing investigations of infiltration rates, migration of salts, effects of pesticide and herbicide applications, potash tailings, and the effects of irrigation development. The recent drought conditions in the province intensified the need for accurate and comprehensive information concerning geology and groundwater supplies. The information systems and expertise developed by the Sedimentary Resources Program have had a significant impact on the success rate of wells drilled in Saskatchewan.

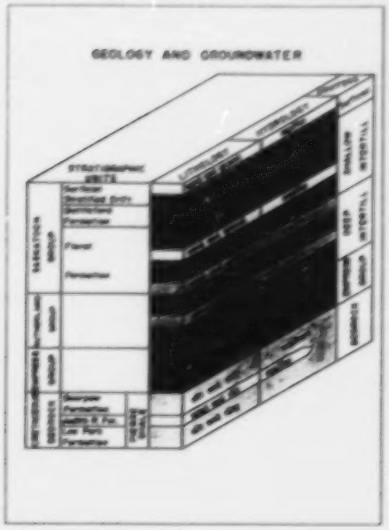
The advanced assessment and modelling systems developed by this group have increased the number of known aggregate reserves, resulting in significant cost savings by reducing hauling distances for Saskatchewan contractors.

Highlights

- Developed a computer-aided mapping system to digitize and generate bedrock contour maps of the plains region. A series of 1:250,000 maps covering Saskatchewan has been completed. Work on the provincial surficial geology map continued.
- Completed aggregate inventories for ten rural municipalities under the Mineral Development Agreement with Saskatchewan Energy and Mines.
- Provided quaternary geology services (glacial drift mapping and analysis) to industries pursuing opportunities in the diamond play area.
- Completed four drift prospecting contracts relating to continued investigations into gold and platinum resources within the province.
- Completed reports on pesticides in groundwater in the Outlook Irrigation Region.
- Monitored groundwater for the Luck Lake Irrigation Project.
- Started groundwater resource study for the Yorkton area to evaluate the quantity and quality of the groundwater resources in the region.

SRC scientists and technicians install a piezometer, used to study the flow and chemistry in tills. These studies are undertaken at various sites throughout the province and provide important information on the quantity and quality of groundwater resources in Saskatchewan.

Staff
J. Campbell (M.Sc.)
E. Jaworski (R.R.Tech.)
H. Maathuis (M.Sc.)
M. Millard (M.Sc.)
M. Simpson (B.A.)
J. Stoutenburg (B.Sc.)
G. van der Kamp (Ph.D.)
T. Warkentin (Chem.Tech.)
D. Zlipko (Water Sci.Tech., C.E.T.)



Stratographic section of quarternary deposits for the Saskatchewan plains region is used in hydrogeological and geotechnical investigations. These investigations are carried out to determine appropriate storage sites for mining operations, for example, or to select suitable locations for major construction projects.

- Installed observation wells and monitoring equipment to improve management of groundwater resources to complete a project in Lesotho, Africa.

Publications

The Sedimentary and Stratigraphy of a Gravelly Meander Lobe in the Saskatchewan River Near Nipawin, Saskatchewan. *Campbell, J.* R-842-57-E-88 (1988)

Quaternary Geology and Till Geochemistry - East Amisk Lake Area, Saskatchewan: Preliminary Report. *Campbell, J.* R-842-59-E-88 (1988)

Study of Herbicides in Shallow Groundwater Beneath Three Irrigated Sites in Outlook Irrigation District, Saskatchewan - Results of 1987 Field Investigations. *Maathuis, H. Wasiuta, V. Nicholaichuk, W. Grover, R.* R-844-13-E-88 (1988)

Manuals and Data Processing Procedures Tuang Phamong Project - Groundwater Study. *Maathuis, H.* R-844-15-E-88 (1988)

Tuang Phamong Rural Development Project, Lesotho: Groundwater Project. *Maathuis, H. Schalm, R.* R-844-16-E-88 (1988)

The Water and Salt Balance of Prairie Wetlands in Relation to Groundwater Flow. *van der Kamp, G.* R-844-17-D-88 (1988)

Procedures Used and Problems Encountered in Compilation of Drillhole Data for Computer Assisted Mapping Project. *Marshall, W. Dyck, J.* R-856-1-E-88 (1988)

Region 13, Western Glaciated Plains. In: The Geology of North America, Volume 0-2, Hydrogeology. *Back, W. Rosenshein, J.S. and Seaso, P.R.*, (Eds.), pp.115-127. *Lennox, D. Maathuis, H. Pederson, D.* R-844-5-A-89 (1989)

Assessment of Oily Waste Disposal on Municipal Roads: Potential Effects on Groundwater Quality. *van der Kamp, G.* R-844-14-E-88 (1988)

Calculation of Constant-Rate Drawdowns from Stepped-Rate Pumping Tests. *van der Kamp, G.* R-844-10-A-88 (1988)

Use of Dimensional Analysis in the Study of Thermal Effects of Various Hydrogeological Regimes. *van der Kamp, G. Bachu, S.* R-844-7-A-88 (1988)

Hydrogeology of Two Saskatchewan Tills: I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow. *Keller, C.K. van der Kamp, G. Cherry, J.A.* R-844-5-A-88 (1988)

Hydrogeology of Two Saskatchewan Tills: II. Occurrence of Sulphate and Implications for Soil Salinity. *Keller, C.K. van der Kamp, G.* R-844-8-A-88 (1988)

SRC hydrogeologist Harm Maathuis is discussing with local technicians the process of how to measure the groundwater levels at a groundwater monitoring station in Lesotho, Africa.

REMOTE SENSING PROGRAM

Manager: Jeff Whiting, M.Sc.

The Remote Sensing Program continued to provide analysis of satellite-generated photographic images to a number of government, institutional and corporate clients. By interpreting data supplied by the Canadian Centre for Remote Sensing in Prince Albert, the group provided valuable information and analysis that aided mineral exploration, petroleum exploration, agricultural planning, crop estimation, as well as monitoring fire damage in the northern forests.

Transfer of remote sensing technology was undertaken through a series of seminars for users and the facilities were made available to students at the University of Saskatchewan, University of Regina, SIAST, and the Northern Institute of Technology in Prince Albert.

Highlights

- Completed a forest inventory mapping project for Weyerhaeuser. Remote sensing data was integrated with soils maps to determine current growth patterns and alternate uses for the land.
- Monitored drought damage to Saskatchewan crop and rangeland for the Saskatchewan Crop Insurance Corporation and Saskatchewan Agriculture and Food.
- Produced a yield assessment of Saskatchewan, showing the various levels of crop yield and forage yield to determine whether drought disaster claims were necessary. By using digital maps, comparisons with previous year yields were attained.
- Established a remote sensing data bank comprised of satellite data dating back to 1983.
- Provided assistance to producers in managing their rangeland by evaluating range and pasture conditions.
- Completed the Saskatchewan Technology Enhancement Program (STEP). This program trained over 100 people in remote sensing and exposed several hundred others to remote sensing technology through seminars and displays.
- Produced maps showing snow amounts and the snow line in a joint Canada/U.S. experiment. The project successfully demonstrated that passive microwave measurement from space is a workable method of mapping snow cover and prediction of spring runoff. This information then helps predict moisture conditions well before the growing season begins, therefore helping farmers decide what crops to plant and where.
- Remote sensing satellite information and computer-aided geographic packages were used successfully to augment present fire detection and forest management methods.

REMOTE SENSING STEERING COMMITTEE

Vern Fowke, President, Saskatchewan Water Corporation (Moose Jaw, Saskatchewan)

Richard Letilley, Acting Deputy Minister Saskatchewan Science & Technology (Saskatoon, Saskatchewan)

John G. Manns, Associate Vice-President (Research) and Dean, College of Graduate Studies, University of Saskatchewan

Doug Mazur, Director, Resource Lands Saskatchewan Parks, Recreation and Culture (Regina, Saskatchewan)

John Turnbull, Central Survey and Mapping, Saskatchewan Property Management Corporation (Regina, Saskatchewan)

Leo Sayn Wittgenstein, Canada Centre for Remote Sensing (Ottawa, Ontario)

Jack Zepp, Manager, Statistics Section, Economics Branch Saskatchewan Agriculture (Regina, Saskatchewan)

REMOTE SENSING USERS' COMMITTEE

Alex Banga, Saskatchewan Water Corporation (Moose Jaw, Saskatchewan)

Syd Barber, Saskatchewan Parks, Recreation & Culture (Regina, Saskatchewan)

Stan Benjamin, Saskatchewan Crop Insurance Corporation (Melville, Saskatchewan)

Eeltje de Jong, Institute of Pedology, University of Saskatchewan (Saskatoon, Saskatchewan

Richard Dobbins, Statistics Canada (Ottawa, Ontario)

Helmut Epp, Canadian Centre for Remote Sensing (Yellowknife, N.W.T.)

Bernie Kallenbach, Saskatchewan Water Corporation (Moose Jaw, Saskatchewan)

Jack Mollard, J.D. Mollard & Associates (Regina, Saskatchewan)

Larry Stanley, Saskatchewan Parks, Recreation and Culture (Regina, Saskatchewan)

Staff
R. Bouvier
R. MacPherson (Commercial Pilot)
N. Nicolichuk (Civ.Eng.Tech.)
J. Polson (B.Sc.)
B.J. Smith

An ink jet plotter is used to produce land resource maps. This map was produced for a gold prospecting company for gold exploration in Saskatchewan's North. Maps are produced from digital data taken by satellites. The data are stored on computer tapes at the Prince Albert Satellite Receiving Station.

Publications

Use of Remotely Sensed Data for Hydrologic Investigations in Wood Buffalo National Park. *Polson, J. Whiting, J.* E-905-14-E-88 (1988)

Using Satellite Information as a Tool for Range Management. *Whiting, J. McCartney, D. Polson, J.* E-905-15-E-88 (1988)

Land Cover Classification of Satellite Imagery For Kootenay and Souris River Basins. *Whiting, J. Polson, J.* E-905-17-E-88 (1988)

Remote Sensing Project - Operational Monitoring of Forage and Crop Yield. *Whiting, J. Nicolichuk, N.* E-905-19-E-88 (1988)

Summary of Results of Petroleum Exploration Company Questionnaires. *Smith, L. Whiting, J.* E-905-21-G-88 (1988)

Summary of Results from Mineral Exploration Questionnaires. *Smith, L. Whiting, J.* E-905-22-G-88 (1988)

Summary of Results of Pulp and Paper Exploration Company Questionnaires. *Smith, L. Whiting, J.* E-905-23-G-88 (1988)

Saskatchewan Remote Sensing Seminar. *Whiting, J. Bouvier, R.* E-905-4-E-89 (1989)

ATMOSPHERIC PROCESSES PROGRAM

Manager: Stan Shewchuk, Ph.D.

The Atmospheric Processes Program worked with government and industry to help maintain acceptable standards and better understand airborne emissions and air pollution. Investigation and monitoring of air quality in both indoor and outdoor environments is important to ensure safe public health standards.

Continued research and development on the effects of acid rain, and the greenhouse warming trends on the environment kept the Atmospheric Processes Program at the forefront in these fields.

Researchers were seeking to develop improved methods for determining the effects of climate change for the agricultural and forestry industries as well as other sectors of the economy.

Emphasis continued on upgrading pesticide spraying technology, developing new and more effective methods of applying agricultural chemicals that will benefit both the farmer and the environment. For example, reducing spray-drift on the farm by just one percent could achieve savings of $1.2 million, since the value of crops lost to weeds in Saskatchewan exceeds $120 million per year.

Highlights

- Conducted several indoor air quality projects to monitor organic compounds, such as asbestos and radon, in the workplace to ensure public health and safety standards are met.
- Researched the impact of changing climate on the forestry industry, and began assessment of the 1988 drought in Saskatchewan.
- Studied the effects of industrial activities such as mining, thermal power generation and deforestation upon the climate; conversely, studied the effects of climate on human activities such as how weather patterns affect crop yields, peoples' health or recreational activities.

Staff
R. Begrand (B.Sc.)
R. Jahren (R.R.Tech.)
K. Wallace (B.Sc.)
E. Wheaton (M.Sc.)
V. Wittrock (B.Sc.)

- Operated the Saskatoon-based Climate Reference Station (CRS) and continued long-term climatology studies. This station continued to serve a number of users who require detailed climatic data on a regular basis.
- A remote weather station was installed at the Luck Lake Irrigation site. The information gathered will determine the irrigation scheduling requirements for the area.
- Assessed and compared a variety of commercial sprayers for spray drift, seeking to reduce farm input costs.
- Continued research concerning the residual effects of pesticide vapour flux activity in the air.

A diffuse solar radiation sensor at the Climate Station in Saskatoon is used to measure the amount of solar radiation from the sky, excluding the direct radiation from the sun. The data are used in models to estimate plant growth, such as forest, grassland and crops, as well as in global climate change studies.

Publications

A Review of Methodology for Measuring the Drift and Deposition of Herbicides and Insecticides for Forestry Applications. *Shewchuk, S. Wallace, K. Maybank, J.* E-906-21-B-88 (1988)

The 1988 Pesticide Flux Trials. *Shewchuk, S.* E-906-30-E-88 (1988)

Risk and Uncertainty in Forest Management: Choosing a Method of Analysis. *Van Kooten, G. Wheaton, E.* E-906-33-B-88 (1988)

An Investigation of the Airborne Particulate Concentration in Marion Graham Collegiate. *Wallace, K.* E-906-39-E-88 (1988)

Progress Report on an Environmental Monitoring Program (1988) to Determine the Effect on Agricultural Operations of the Poplar River Power Plant. *Shewchuk, S. Abouguendia, Z.* E-906-40-E-88 (1988)

Agrometeorological Activity in Saskatchewan November, 1987 to October, 1988: *Wheaton, E.* E-906-52-D-88 (1988)

The Role and Importance of Particulate Matter in Precipitation Chemistry in Western and Northern Canada: A Problem Analysis. *Shewchuk, S.* E-906-53-D-88 (1988)

Methodology for Measuring the Drift of Pesticides in Forestry Applications. *Shewchuk, S.* E-906-56-D-88 (1988)

The Carbon Cycle and Recent Temperature Trends in Saskatchewan. *Shewchuk, S.* E-906-59-D-88 (1988)

Testing the Effectiveness of Reduced Rate Herbicide Applicators. *Maybank, J. Grover, R.* E-910-3-D-88 (1988)

Saskatoon SRC Climatological Reference Station Annual Summary, 1988. *Wittrock, V. Begrand, R. Wheaton, E.* E-906-2-B-89 (1989)

Novel Approaches to the Measurement of Pesticide Spray Drift and Ground Coverage: A Preliminary Report. *Wallace, K. Jahren, R.* E-906-3-E-89 (1989)

The Carbon Cycle and Global Climatic Change. *Shewchuk, S.* E-906-6-D-89 (1989)

Using Climatic Change Scenarios to Model Agroclimatic and Ecoclimatic Consequences. *Wheaton, E.* E-906-12-D-89 (1989)

Changing Climatic Resources for the Western Canadian Boreal Forest. *Wheaton, E. Thorpe, J.* E-906-14-D-89 (1989)

Hans Peterson, an algae and weed control expert, examines heavy duck weed growth on the surface of an SRC experimental pond. Floating duck weed mats are used to shade out algae growth in farm ponds.

AQUATIC BIOLOGY PROGRAM

Manager: Stella Swanson, Ph.D.

The scientists and researchers of the Aquatic Biology Program provided aquatic toxicity testing services for the monitoring of water quality. Expansion and refinement of a set of biological testing procedures has resulted in accurate investigation of the effects of water-borne contaminants, such as metals, pesticides, organic compounds and complex municipal and industrial wastes. A Quality Assurance/Quality Control Program was developed to ensure the reliability of the tests.

An important part of the work undertaken by this program involved the control of blue/green algae, a serious problem affecting the dugouts of Saskatchewan farmers. Discoveries have led to the development of cost efficient procedures that effectively control algae blooms and retain and reclaim productive use of a much needed resource. A province-wide informational tour and several demonstration projects were conducted to transfer this technology to the people of Saskatchewan. This water treatment procedure can provide reliable supplies of potable water to areas where water supplies have been affected by algae and alternate sources are not feasible. The procedure can also reduce costs and increase efficiency of traditional water treatment methods.

Highlights

- Aquatic toxicology capabilities were expanded by refining a set of standard aquatic tests using algae, invertebrates, and rainbow trout. These tests are suitable for identifying a wide variety of water-borne contaminants, including metals, pesticides, other organic compounds, and complex wastes from municipalities and industry.
- A formal Quality Assurance/Quality Control Program was developed and implemented.
- Tested the herbicide Hoe-Grass in aquatic micro-ecosystems to assess its environmental toxicity in natural ponds.
- Developed several promising treatments, including physical and biological methods, for algae control in farm ponds. The project aimed at pinpointing the causes of persistent algae blooms and strived to identify successful treatment methods.
- Major environmental impact/monitoring studies were completed for:
  - Dominique-Janine development of Cluff Mining
  - The proposed test uranium mine of the Midwest Lake Joint Venture
  - The Thor Lake beryllium mine/North West Territories
- Completed a bioassessment of the South Saskatchewan River. Other toxicity test projects included testing of uranium effluents, and water downstream of two chemical plants on the South Saskatchewan River.

Staff
J. Matamala
G. Melville (Ph.D.)
M. Moody (B.Sc.)
B. Paquin (R.R.Tech.)
H. Peterson (Ph.D.)
D. Richert (R.R.Tech.)
C. Rickard (R.R.Tech.)

Publications

Natural Uranium Series Radionuclides in the Upland Vegetation of Northern Saskatchewan and Adjacent Northwest Territories. *Sheard, J. Swanson, S. Godwin, B.* E-901-9-B-88 (1988)

Investigation of the Toxicity to Aquatic Biota of Oily Wastes from the Heavy Oil Industry. *Tones, P. Swanson, S.* E-901-11-E-88 (1988)

Results of Algae, Invertebrate and Fish Bioassays Conducted on Uranium Mine Effluents. *Swanson, S. Melville, G. Peterson, H.* E-901-16-E-88 (1988)

Algae Control in Farm Ponds: Progress Report. *Peterson, H. Swanson, S.* E-901-17-E-88 (1988)

Physical, Chemical and Biological Warfare Against Algae. *Peterson, H. Swanson, S.* E-901-18-D-88 (1988)

Results of Algae, Invertebrate and Fish Bioassays on South Saskatchewan River Effluent Mixing Zones. *Swanson, S. Melville, G. Peterson, H.* E-901-23-E-88 (1988)

Luck Lake Irrigation Project Water Quality Monitoring Plan. *Swanson, S.* E-901-21-E-88 (1988)

Thor Lake Area (NWT) Environmental Baseline Survey. *Melville, G. Godwin, B. Russell, D. Polson, J.* E-901-1-E-89 (1989)

Regina Stormwater Retention Ponds: Physical, Chemical, and Biological Water Quality Study. *Peterson, H.* E-901-2-E-89 (1989)

Algae Control in Farm Ponds. *Peterson, H.* E-901-7-E-89 (1989)

Toxicity of Diclofop-methyl and Fenoaxaprop-ethyl to Aquatic Organisms: A Progress Report to Pestfund, Environment Canada. *Swanson, S. Lintott, D.* E-901-10-E-89 (1989)

Bioassessment for the South Saskatchewan River Study. *Melville, G. Swanson, S. Irvine, D. Rickard, C. Peterson, H.* E-901-3-E-89 (1989)

Mary Moody, a technician in the microbiology laboratory, cultures and tests algae to develop new control methods and to determine toxicity of environmental contaminants.

Dan Richert, SRC research technician, collects water samples from a Saskatchewan lake as part of a monitoring project to ensure acceptable water quality is maintained.

TERRESTRIAL ECOLOGY AND ARCHAEOLOGY PROGRAM

Manager: Zoheir Abouguendia, M.Sc., P.Ag.

Rick Lauzon, a field researcher at SRC, applies drilling wastes in a controlled field experiment in the Lloydminster area to assess the effect of drilling wastes on soils and crops.

The Terrestrial Ecology and Archaeology Program provided industry and government with expertise and services that helped understand the effects of industrial development on Saskatchewan's soils and land. Studies were carried out that evaluated the effects of oil and gas drilling wastes, the application of oil wastes on municipal roads, and baseline surveys on vegetation and wildlife in the north. A three year project was started that will assist the ranchers of Saskatchewan to improve productivity and develop new rangeland management techniques.

The Archaeology aspect of the program encompassed studies and excavation of sites, inventory of artifacts, and developing means to preserve Saskatchewan archaeology sites in harmony with industrial and urban developments.

Highlights

- Entered into the third phase of a study to evaluate the potential effects of oil and gas drilling wastes on soils and crops. This phase involved controlled field applications of the wastes in different regions of Saskatchewan.
- Conducted an environmental study that indicated a potential for using oily wastes to improve the surface of grid roads with little or no negative environmental effects.
- Monitored crops and soils in the Coronach, Saskatchewan area to evaluate environmental effects of airborne emissions from the Poplar River Thermal Power Plant.
- Conducted vegetation and wildlife baseline surveys in Thor Lake (NWT) in conjunction with the proposed Island Falls Transmission Line.
- Developed a rangeland planning guide for Saskatchewan livestock producers.
- Presented a series of lectures on rangeland management and improvement at the Institute of Grassland Sciences, Northeast Normal University, Cangchun, People's Republic of China.
- Excavated fourteen archaeological sites in the Rafferty Reservoir as part of a major investigation of the Late Prehistoric time period. A study of the homesteading period in the same area is also underway.
- Introduced Saskatchewan's first developer-funded Archaeology Program. Through this program several hundred students gained first-hand experience with archaeological field work and learned excavation techniques at three sites in the Souris River basin.
- Developed an interactive Site Data Base for the Rafferty and Alameda sites that provides text and graphics data on archaeological items.

Staff

C. Beaulieu (B.A)
B. Ferris (B.A.)
J. Finnigan (M.A.)
B. Godwin (B.S.A.)
O. Klimko (M.A.)
R. Lauzon (B.Sc.)
P. McKeand (B.A.)
M. Rollans (M.Sc.)
D. Russell (B.A.)

- Co-hosted a workshop at Whistler, B.C., on Fur Trade Archaeology.

Publications

Report on a Range Management Lecture Program Presented at Northeastern Normal University, Changchun, People's Republic of China. *Abouguendia, Z.* E-902-7-E-88 (1988)

Potential Effects of Oily Waste Disposal on the Terrestrial Environment - An Overview. *Godwin, R. Abouguendia, Z.* E-902-8-E-88 (1988)

The Poplar River Agricultural/Environmental Monitoring Program, 1988 - A Progress Report. *Abouguendia, Z Shewchuk, S.* E-902-10-E-88 (1988)

Land Application of Drilling Wastes - Phase III, Field Experiments - A Progress Report. *Abouguendia, Z.* E-902-11-E-88 (1988)

Improvement of Rangeland of Southern Saskatchewan - A Progress Report. *Abouguendia, Z.* E-902-15-E-88 (1988)

The Old Women's Phase on the Saskatchewan Plains - Some Ideas. *Meyer, D.* E-903-5-A-88 (1988)

Souris Basin Heritage Study - 1987 Investigations at the Rafferty and Alameda Reservoirs. *Finnigan, J.* With contributions by *McKeand, P. Russell, D.* E-903-7-E-88 (1988)

Report on the Heritage Investigations of the Rural Municipality of Val Marie Road. *Rollans, M.* E-903-9-E-88 (1988)

The Selkirk Composite of Central Canada: A Reconsideration in Arctic Anthropology, 1987: 1-31. *Meyer, D. Russell, D.*

The Avonlea Type Site Revisited: A Report on Excavations and Ceramic Analysis. *Klimko, O. Hanna, M.* In: Avonlea Yesterday and Today: Archaeology and Prehistory, edited by L.B. Davis, pp. 25-31

Northernmost Avonlea in Saskatchewan. *Mayer, D. Klimko, O. Finnigan, J.* In: Avonlea Yesterday and Today: Archaeology and Prehistory, edited by L.B. Davis, pp. 33-42

The Marr Residence: Field Hospital and Home. *Klimko, O.* In: Out of the Past: Sites, Digs and Artifacts in the Saskatoon Area, edited by V. Linnamae and T. Jones, pp. 117-130

Native Groups in the Saskatoon Area in the 1700s and 1800s. *Russell, D.* In: Out of the Past: Sites, Digs and Artifacts in the Saskatoon Area, edited by V. Linnamae and T. Jones, pp. 117-130

1988 School Tours of Estevan Area Sites. *Rollans, M.* In: Saskatchewan Archaeology Society Newsletter, 1988, pp. 119-121

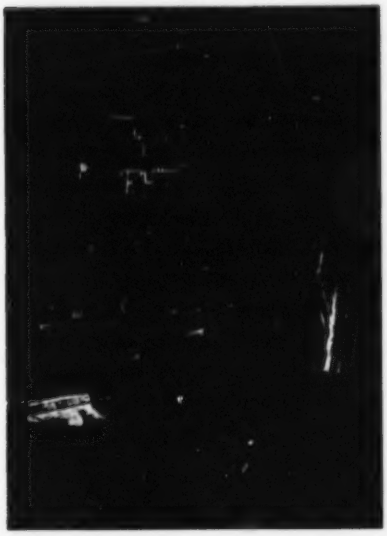
Homesteading on the Prairies. *Klimko, O.* A paper presented at the 21st Annual Chacmool Conference, Calgary (November 1988)

Tenting on the Souris. *Finnigan, J.* A paper presented at the 21st Annual Chacmool Conference, Calgary (November 1988)

SRC archaeologists have been involved in over 75 archaeological studies since the late 70's, including the large impact mitigation studies associated with the Nipawin and Rafferty Reservoirs. At the Sanderson Kill site near the Rafferty Dam, a public dig was created to give Saskatchewan school children from the Estevan area a hands-on experience in heritage preservation.

TECHNOLOGY TRANSFER AND BUSINESS DEVELOPMENT BRANCH

Vice President: Ravi Maithel, M.Sc., P.Eng.
Staff: Judy Poon, B.Comm., Linda Kunstmann, John Bergsteinsson, B.Sc.,B.Ed



Electronics and instrumentation specialist Ken Babich is laying out an electronic circuit for a specialized instrumentation project, with the help of computer-aided design (CAD/CAM).

INNOVATION DIVISION

Director: John Spankie, B.Sc. P.Eng.

The division continued to provide Saskatchewan business, industry, and government with a complete range of new product development services.

To assist manufacturers in Saskatchewan, the division developed and introduced an integrated productivity approach called "Cost Leadership". The division also provided other services that included Material Requirement Planning (MRP) and Distribution Resources Planning (DRP). These approaches addressed specific needs of the provincial manufacturing sector.

Clients with new product ideas were provided with the following services: product feasibility studies, preliminary market research, product design or redesign, building of prototypes and identification of financing sources.

Highlights

- Conducted technology transfer seminars concerning Distribution Resource Planning (DRP) for Saskatchewan industry.
- Identified applications for Computer-Aided Design (CAD).
- Conducted a plant productivity and efficiency study.
- Assisted clients in a range of projects involving "Cost Leadership" for a number of Saskatchewan firms.
- Addressed the concept of "Cost Leadership" and technology adaption by small and medium sized enterprises in Thailand and Singapore.

Publications

Catalogue of Opportunities for Rural Areas (CORA). *Barnett, D.* M-4502-4-E-88 (1988)

Technology Adoption by Small and Medium-Sized Enterprises in Malaysia: Final Report. *Maithel, R.* I-4501-2-E-88 (1988)

Saskatchewan Researchers Work With Manufacturers in Thailand. *Maithel, R. Sarkar, A.* I-741-17-G-88 (1988)

Distribution Resource Planning Using an Innovative Approach to Solving Inventory Control and Purchasing Problems. *Hansen, C.* I-4503-1-D-88 (1988)

Staff
C. Hansen (M.B.A., B.Sc.)
L. Smith (B.Comm.)

CANADIAN CENTRE FOR ADVANCED INSTRUMENTATION (CCAI)

Precision Instruments Group
Manager: Orville Olm

Electronics Group
Manager: Kim Young, B.Sc., Elec. Tech.

The Canadian Centre for Advanced Instrumentation (CCAI) took an integrated approach to practical problem solving for SRC clients. Identifying the need for specialized plastics moulding systems, the Precision Instruments Group of engineers and technologists delivered these services to western Canadian industry.

Researching and developing new products and processes, the group specialized in the design and manufacture of high pressure moulding systems for structural foam, thermofoam, and the rotomoulding of plastics. Besides offering these services on a contract basis, the group entered into a number of co-ventures and have come to share two registered industrial designs and one patent as a result of these activities.

Concentrating on solving measurement and control problems, the Electronics Group, working under contract, provided complete instrumentation design and production services for Saskatchewan industry. The group also sought co-venture arrangements for the commercialization of new instrumentation products.

The development and manufacture of the MiniTube Air Sampler, the first automated air sampling instrument that will efficiently collect and analyze airborne contaminants in the form of gases, vapours and aerosols, found widespread application in the industrial and agricultural sectors.

Technologist Graeme van Dongen is a CAM (computer assisted manufacturing) expert, who programs and operates automated and computerized manufacturing tools. He primarily works at the CNC (computer numerical control) vertical milling centre, used in the manufacture of plastics injection moulds.

Highlights

- Designed, developed, manufactured a new Automated Thermal Desorption Unit. Units were marketed to the Canadian Department of Defence and the United States Airforce.
- Expanded business operations nationally, developing client groups in British Columbia, Alberta, Manitoba, and Ontario.
- Completed two joint venture product design projects with the Manitoba Technology Centre.
- Designed and developed a new lighting display control system for a Saskatchewan outdoor lighting company.
- Prototype wireless seed monitor designed and developed for a Scoby, Montana company.
- Designed and developed a remote Compact Transmitter for the MiniTube Air Sampler now in use at the Canadian Defence Research Station, Suffield, Alberta.
- Installed MiniTube AirFlow Monitors at the Saskatchewan Research Council.

Staff
K. Babich
R. Mathieshin
M. Peters
B. Seymour (CAD/CAM Tech.)
G. van Dongen

IRAP technical advisors provide technical information, advice and guidance to industry and manufacturing firms throughout Saskatchewan. Primarily designed to assist small and medium-sized firms in Saskatchewan, the program has been used to improve wild rice production in northern Saskatchewan.

- Completed thirty plastics design projects, thirteen prototype mould systems, and sixteen production moulds for plastic injection moulding.

Publications

Minitube (TM) Water Sampler Operator's Manual. *Locke, T. Young, K.* I-797-1-E-88 (1988)

Minitube (TM) Dryer Operator's Manual. *Young, K. Locke, T.* I-4794-1-E-88 (1988)

TECHNOLOGY SERVICES DIVISION

Director: Dave Grier, B.Sc. P.Eng.

The Technology Services Division engineers and technicians provided in-plant technical assistance to Saskatchewan's industrial sector. The division delivered services offered under the National Research Council's Industrial Research Assistance Program (IRAP). This national program provided technical information and industrial engineering expertise, on a cost-shared basis, to client firms in the province of Saskatchewan.

The division also began expanding operations beyond the IRAP program and carried out a number of projects in the mechanical, electronic, and industrial marketing fields. To reflect these expanded services the name of the division was changed from Field Services Division to Technology Services Division in 1988-89.

Highlights

- Largest provincial delivery agent for the Industrial Research Assistance Program. Provided technical expertise resulting in approximately $1.5 million of industrial research and development undertaken in the Saskatchewan manufacturing and construction sectors.
- Conducted a technology transfer seminar for the Saskatoon Construction Association.

Staff
D. Glossop (P.Eng.)
G. Kocdag (B.Sc.)
C. Kuchinka (B.E., P.Eng.)
R. Levesque (B.Sc., P.Eng.)
F. Popoff (B.A.C.)
J. Sher (B.Sc., P.Eng.)
L. Sopher (B.Ed.)
R. Wong (B.E., P.Eng.)
B. Zuk (B.A., B.Sc., P.Eng.)

MISSION: IRAP

"To the extent the technology is needed, our mission is to help the Canadian firm to be more competitive in its markets."

PRODUCT AND PROCESS DEVELOPMENT DIVISION

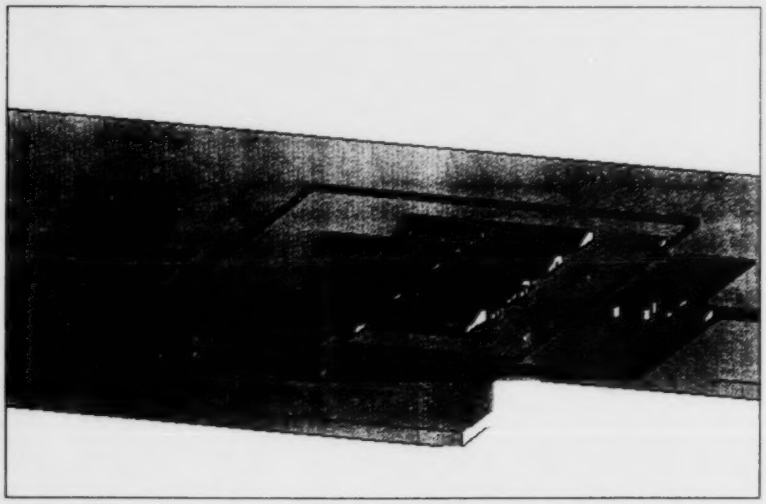
Director: Gordon Pierce, M.Sc., P.Eng.

The Product and Process Development Division served the Saskatchewan manufacturing sector with integrated computer-aided design and computer aided manufacturing (CAD/CAM) services. The division's engineers and technicians also applied the techniques of Finite Element Analysis and Integrated Computer-Aided Engineering/Manufacturing (ICEM) to solve production problems for several Saskatchewan firms.

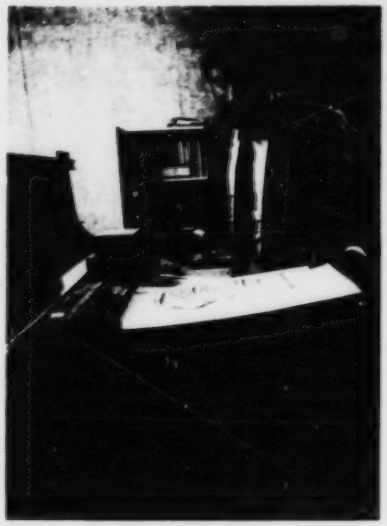
Product and Process technology transfer training sessions were held in the SRC Computer Laboratory to complement field sessions at the client's plant. The division provided complete project services, as well, specific services or equipment were supplied to solve individual client problems.

Highlights

- Provided design, redesign, and/or technical analysis for a broad range of products; grain bins, water conditioning equipment, logging and grain trailers, potash mining equipment, grain seeder, scaffolding, propane heater, storage tanks, logging equipment, hay processing equipment, oil pump components, and a children's lunchbox.
- Provided Finite Element Analysis, CAD/CAM, Computer-Aided Drafting, and Computer Solid Modelling to over twenty Saskatchewan companies.
- Provided computer support to all SRC divisions; instituted a council-wide electronic mail service and provided special communication services to port the Remote Sensing Software to the mainframe computer.



This computer generated model of a disease-free swine production facility was created with the help of CAD/CAM equipment. Computers were used to develop a system for conceptualizing and designing other implementations of this facility.



State-of-the-art equipment is used to produce high quality line drawings of the designs developed on computer screens in the division. CAD CAM specialist Richard Reich uses a multipen drum plotter to generate a series of bedrock surface maps for an exploration company.

Staff

D. Florizone (Mech.Eng.Tech.)
K. Holdstock (Micro Computer Mgmt. Tech.)
C. Jahren (B.A.)
T. Kaminski (Ph.D.)
A. Malinoski (B.Sc., P.Eng.)
C. McKenzie (M.B.A., P.Eng.)
R. Reich (Arch.Tech.)
A. Udell (CAD/CAM Tech.)

Administration and Finance Branch

Vice President: George MacKay, B.A.

Graphics staff produce the layout and design for SRC News. Graphics designer Hans Piek and former editor Bryce Erickson select photographs for an upcoming issue of the quarterly newsletter.

Financial Services Staff
Controller: R.J. McGrath (M.B.A.)
M. Dymond, B. Hoyseth, M. Millhouse

Human Resources Staff
Manager: J. Sanderson (B.B.A.)
R. Dick (F.R.I., B.A.), M. Limet

Safety Officer
J. Meginbir (B.A.)

Shops and Facilities Staff
Manager: K. Owens (B.A.C.)
I. Coleman, D. Friesen (B.A.), J. Hunter, A. MacEwen, B. Marshall, D. McEwan, G. McLean, W. Reilkoff, M. Timmins, T. Voth, J. Wright

Departmental Services Staff
Manager: D. Collins
G. Calderon, B. Dampsey, D. Diduck, M. Nelson, S. Niyazi, R. Reed, P. Sherwood, B. Thomson

Information Centre Staff
Manager: M. Samms (Lib.Tech.)
H. Acton, C. MacLeod, R. Middleton, K. Sthankiya (Lib.Tech.)

Publications Coordinator
L. Weegar

Graphics Staff
Coordinator: C. Sardinha (C.C.)
J. Mamer, B. McIntosh (C.C.), E. Perkins, H.G. Piek

The Administration and Finance Branch continued to be responsible for administration services that ensure efficient operation of the organization. Human Resources, Departmental Services, Graphics Services, Safety Officer, Shops and Facilities, Accounting, and the Information Centre provided internal support services to all SRC program areas. Two of SRC's laboratories, Analytical Services, and the Bovine Blood Typing Laboratory are also included in the Administration and Finance Branch.

Highlights

- Completion and implementation of SRC Job Evaluation system.
- Delivery of SRC Performance Management Training Program.
- Coordinators of the Partnerships in Education Program with the Saskatoon Catholic Board of Education, and establishment of a partnership with Bishop James Mahoney High School.
- Development of the Implementation Strategy for Employment Equity.
- Implementation of a Smoke Free Policy.
- Departmental Services' staff participated in the preparation of 382 scientific/technical reports.
- Safety Officer initiated the implementation of the federally legislated Workplace Hazardous Materials Information System.
- Graphics Department offered a variety of services to internal and external clients.
- The Facilities Group aided in the completion of the West Addition and the relocation of SRC staff from 30 Campus Drive to the W.H.W. Husband Wing.
- The Facilities Group decommissioned 30 Campus Drive and handed the building over to the University. The storage facilities at Packham were moved into the Annex.
- The new laboratories for the Bovine Blood Typing and DNA programs were prepared for occupation.
- The Publications Coordinator's role was established for the coordination of all SRC publications and reports.
- Information Services automated the list of journals on file (680) providing instant access for users and more efficient accountability. A purchase order database was put into operation for improved acquisitioning.
- SRC developed and successfully implemented Year One of Prairie Agricultural Machinery Institute's (PAMI) five-year Strategic Plan.

Publications

Standard Practice Manual. *MacKay, G. Dick, R.* A-750-2-H-88 (1988)

Publication Guidelines. *Weegar, L.* A-750-3-E-88 (1988)

ANALYTICAL SERVICES LABORATORY

Director: G. Smithson, Ph.D., P.Eng.

The Analytical Services laboratory provided chemical, radiochemical and materials analysis services for industrial, commercial and government clients in Saskatchewan. The laboratory provided quick response to emergency situations involving analysis of samples resulting from chemical spills, environmental spills and prompt identification of hazardous substances.

Analytical Services also encompasses the Radiocarbon-14 Laboratory, which provided accurate dating of materials by measuring the amount of radioactive carbon-14 isotope present in the sample. This service is provided for archaeologists, museums and university departments.

Specialized services provided to the uranium industry have gained Analytical Services a worldwide reputation in environmental radiochemical analysis.

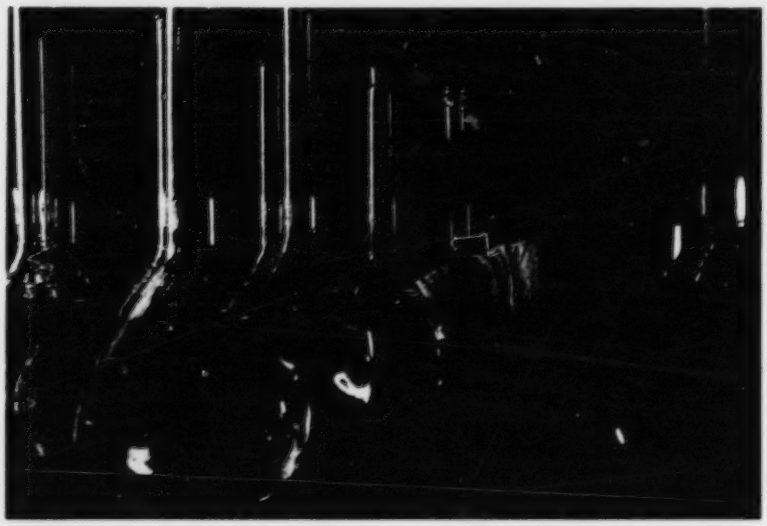
Radiochemical technician Surrinder Magon observes the process of isolation of organometallic complexes by solvent extraction.

Highlights

- Provided a workshop on plasma-emission and plasma-mass spectrometry for the Analytical Sub-Group of the Canadian Uranium Producers Metallurgical Committee.
- The Carbon-14 Dating Laboratory moved to the new West Wing addition of the Sedco Centre; new equipment was installed to update the radioactive counting technique from gas counting to liquid scintillation counting.
- A new service introduced in early 1989 measures radon in the home and other buildings.

Publications

Slowpoke II Facility Annual Compliance Report. *Smithson, G.* S-803-1-E-88 (1988)



Jeff Zimmer, a radiochemical technician, is preparing reagents for analytical measurement.

Staff

S. Barnes (Chem.Tech.)
M. Brenner (Chem.Tech.)
D. Chorney (Chem.Tech.)
L. Chrusch (B.Sc.)
L. Didur
G. Drader (Chem.Tech.)
V. Evans
M. Fahri (B.Sc.)
I. Khosla
J. Ma (B.Sc.)
L. MacDonald
S. Magon
P. Moser (Chem.Tech.)
S. Punani (M.Sc.)
B. Sarich
G. Shutiak (Chem.Tech.)
B. Stanek (B.Sc.)
S. Woo (Chem.Tech.)
P. Yeung (Chem.Tech.)
W. Yuen (Ph.D.)
J. Zimmer (Chem.Tech.)

BOVINE BLOOD TYPING LABORATORY ADVISORY BOARD

Ken Aylesworth, General Manager
Canadian Charolais Association
(Calgary, Alberta)

Henry Begrand, President
Canadian Charolais Association
(St. Louis, Saskatchewan)

Glenn Cherry, Registrar
Holstein Association of Canada
(Brantford, Ontario)

David Christensen, Head,
Animal & Poultry Science
University of Saskatchewan
(Saskatoon, Saskatchewan)

David H. Clemons, Chief Executive Officer, Holstein Association of Canada
(Brantford, Ontario)

Mel Gosling,
Canadian Limousine Association
(Dalmead, Alberta)

Enid Jansen, Office Manager
Canadian Gelbvieh Association
(Calgary, Alberta)

Brian Kitchen, General Manager
Canadian Simmental Association
(Calgary, Alberta)

William Small, President
Canadian Simmental Association
(Calgary, Alberta)

Harvey Tedford, Secretary-Manager
Canadian Limousine Association
(Calgary, Alberta)

Staff
S. Grams (B.Sc.)
K. Grayson
U. Hollman
M. Latwat
Y. Plante (Ph.D.)
L. Polishchuk
D. Wright (R.T.).

BOVINE BLOOD TYPING LABORATORY

Manager: Gerry Kraay, Ph.D.

The Bovine Blood Typing Laboratory is the Canadian parentage testing centre serving cattle breeders and exporters. The laboratory continued to work with the cattle industry under the direction of Bova-Can Parentage Testing Inc., an advisory board made up of several national Breed Associations. With this direction, the laboratory provided technical support for bovine genetic research, as well as simplifying record keeping and confirmation of pedigrees to individual breeders and cattle breeding organizations in Canada.

Highlights

- The testing of approximately 23,000 bovine samples represented an increase of 17 percent for laboratory services provided to the Canadian livestock industry.
- A new program to test the purity of elk on game ranches provided testing for approximately 820 animals.
- Commercial DNA testing available for cattle breeders with a state-of-the-art DNA laboratory.

Registered technologists Deanna Wright and Laurie Polishchuk read and interpret the results from a page gel test. The page gel test determines the various types of proteins found in blood serum and is one of several procedures used in the process of determining parentage of purebred cattle.

THE SASKATCHEWAN RESEARCH COUNCIL

FINANCIAL STATEMENTS

Year Ended March 31, 1989

AUDITOR'S REPORT

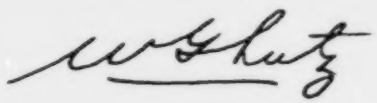
To the Members of the Legislative Assembly of Saskatchewan

I have examined the balance sheet of The Saskatchewan Research Council as at March 31, 1989 and the statements of revenue, expenditure and accumulated surplus and changes in financial position for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Council as at March 31, 1989 and the results of its operations and the changes in its financial position for the year then ended in accordance with the accounting principles described in Note 2 to the financial statements applied on a basis consistent with that of the preceding year.

Regina, Saskatchewan
May 12, 1989

W.G. Lutz, F.C.A.,
Provincial Auditor



Statement 1

BALANCE SHEET

as at March 31, 1989

ASSETS	1989	1988
Current assets:		
Accounts receivable	$2,941,245	$2,599,761
Prepaid expenses	16,581	12,375
Inventory	78,639	217,565
	3,036,465	2,829,701
Deferred charges (Note 3 & 7)	320,877	202,631
Fixed assets (Note 4)	3,382,907	3,235,550
Other assets	3,992	3,967
	$6,744,241	$6,271,849

LIABILITIES AND PROVINCE'S EQUITY		
Current liabilities:		
Bank indebtedness (Note 5)	$2,789,094	$2,648,073
Research grants payable	63,421	96,069
Accounts payable	1,853,911	750,616
Employee deductions payable	251,784	248,299
Deferred revenue (Note 6)	413,791	809,343
Vacation and benefits payable	176,748	207,277
Retroactive salaries payable (Note 8)	90,000	250,000
	5,638,749	5,009,677
Non-current liabilities:		
Sick leave benefits payable	320,797	327,137
Deferred revenue (Note 6)	310,289	474,009
	6,269,835	5,810,823
Province's equity:		
Accumulated surplus (Statement 2)	474,406	461,026
	$6,744,241	$6,271,849

(See accompanying notes to the financial statements)

Statement 2

THE SASKATCHEWAN RESEARCH COUNCIL
STATEMENT OF REVENUE, EXPENDITURE AND ACCUMULATED SURPLUS

Year Ended March 31, 1989

	1989	1988
Revenue:		
Contracts (Note 6)	$ 9,691,338	$ 8,443,994
Provincial government grant	7,379,100	7,640,300
Other (Note 6)	86,563	268,108
	17,157,001	16,352,402
Expenditure:		
Salaries	8,040,592	7,982,543
Employee benefits	786,193	689,889
Supplies and technical services	3,032,644	3,038,187
Depreciation	1,006,615	939,762
Travel and vehicle operations	452,656	330,858
Rent and utilities	2,633,423	2,716,055
Printing and publishing	257,257	167,655
Communications	403,715	345,123
Research grants	67,000	96,069
Other	463,526	317,703
	17,143,621	16,623,844
Surplus (deficit) excess of revenue over expenditure	13,380	(271,442)
Accumulated surplus, beginning of year	461,026	732,468
Accumulated surplus, end of year - (Statement 1)	$ 474,406	$ 461,026

(See accompanying notes to the financial statements)

Statement 3

THE SASKATCHEWAN RESEARCH COUNCIL
STATEMENT OF CHANGES IN FINANCIAL POSITION

Year Ended March 31, 1989

	1989	1988
Cash provided by (used in):		
Operating Activities:		
Surplus (deficit) excess of revenue over expenditure	$ 13,380	$ (271,442)
Add (deduct) items not affecting cash:		
Depreciation	1,006,615	939,762
Amortization of deferred revenue	(809,343)	(400,185)
Loss on disposal of fixed assets	24,408	481
Decrease (increase) in deferred charges	(118,246)	26,753
Decrease in sick leave benefits payable	(6,339)	(7,790)
	110,475	287,579
Net change in non-cash working capital balances related to operations (Note 9)	926,908	396,642
Net cash (used in) provided by Operating Activities	1,037,383	684,221
Investment Activities:		
Purchase of other assets	(25)	(28)
Purchase of fixed assets	(1,197,504)	(1,242,177)
Proceeds from sale of fixed assets	19,125	2,750
Net cash (used in) Investment Activities	(1,178,404)	(1,239,455)
(Decrease) in cash position	(141,021)	(555,234)
Bank indebtedness, beginning of year	(2,648,073)	(2,092,839)
Bank indebtedness, end of year	$(2,789,094)	$(2,648,073)

(See accompanying notes to the financial statements)

NOTES TO THE FINANCIAL STATEMENTS

1. Status of the Saskatchewan Research Council

The Saskatchewan Research Council was established pursuant to Section 3 of the Research Council Act for the purpose of research and investigation in the fields of the physical sciences, pure and applied, as they affect the economy of the Province of Saskatchewan. The Council is a body corporate which receives monies appropriated by the Legislature for these purposes and is also empowered to conduct research under contract for others and to receive financial assistance pursuant to agreements with other similar agencies.

2. Summary of Accounting Policies

a) Revenue Recognition

Grants received for specific purposes are included in revenue to the extent of related expenses incurred during the year. Grant receipts in excess of related expenses are reflected as deferred grant revenue.

Revenue from the majority of contract work is recognized on the percentage-of-completion method which recognizes revenue as a contract progresses. Unbilled revenues are accrued to the year end for these contracts, while pre-billed revenues received are classified as deferred revenue.

b) Inventory

Inventory consists of general supplies and goods held for resale. Inventories are valued at the lower of cost or net realizable value.

c) Fixed Assets

The assets of the Council are initially recorded at cost, including labour, material and overhead for self-constructed assets.

Depreciation is provided over the estimated useful lives of the assets on the following basis:

i) Sum-of-the-years'-digits method	
Buildings	20 years
Leasehold improvements	5 years
Equipment	10 years
ii) Declining balance method	
Automotive	33 1/3%

d) Pension Costs

The Council participates with its employees in a defined benefit pension plan. Pension costs are determined using the projected accrued benefit cost method pro-rated on service. This cost reflects estimated plan investment yields, salary increases, mortality of members, terminations and the ages at which members will retire. Adjustments arising from plan amendments, experience gains and losses and changes in assumptions are amortized over the estimated average remaining service lives of employees.

e) Research Grants

Research grants awarded annually by the Council to aid in funding approved research projects are charged to expenditure in the year in which costs are incurred on the projects.

f) Accrued Vacation Credits

The costs associated with vacation credits are recognized when the vacation entitlements are earned. The value of credits plus associated employee benefit costs earned to the year end but not taken are reflected as a liability.

g) Sick Leave Benefits

The Council allows unused sick leave credits to accumulate over the term of employment for each employee and pays out 10% of the unused accumulated sick leave based on the wage rate in effect at the time of termination of employment. The costs associated with these sick leave benefits are recognized when benefits are earned and accumulated by employees at a rate of 10% of the unused accumulated value of credits earned.

3. Pension Plan

The Council maintains a defined benefit pension plan which provides retirement benefits for essentially all employees. The plan provides for pensions based on employees' years of service and their highest five years of earnings.

Actuarial projections prepared during the year indicate as at March 31:

	1989
Pension fund assets (at market-related value)	$ 14,810,000
Present value of accrued pension benefits	$ 12,026,000

The difference between the amounts expensed and the funding contributions of $210,000 has been reflected in the balance sheet as a deferred charge.

4. Fixed Assets

	Cost	Accumulated Depreciation	1989 Net Book Value	1988 Net Book Value
Buildings	$ 756,860	$ 536,326	$ 220,534	$ 258,763
Leasehold Improvements	646,296	579,976	66,320	117,015
Equipment	8,508,231	5,448,713	3,059,518	2,820,470
Automotive	234,506	228,971	5,535	8,302
Land	31,000		31,000	31,000
	$10,176,893	$6,793,986	$3,382,907	$3,235,550

5. Bank Indebtedness

The Saskatchewan Research Council is authorized under sections 41 and 59 of The Department of Finance Act, 1983, to establish a line of credit not to exceed $2,900,000. There is an assignment of the accounts receivable as collateral for bank indebtedness.

6. Deferred Revenue

a) Potash Corporation of Saskatchewan

The Council has deferred revenue of $108,043 from the Potash Corporation of Saskatchewan for prepaid rent of a pilot plant. The revenue is being reflected in the accounts by the sum-of-the-years'-digits method over the 10 year term of the agreement which commenced in the 1981/82 fiscal year. The current portion of this deferred revenue is $56,415 and is classified accordingly on the balance sheet while the amount included in other revenue in the current year is $61,157 (1988 - $65,899).

b) Government of Canada

The Council has deferred revenue of $365,961 from the federal government under an agreement to jointly fund the costs of operating the Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) Centre. The revenue attributable to capital costs is being amortized in the accounts by the sum-of-the-years'-digits method over a 10 year period which corresponds to the depreciation period of the assets purchased under the terms of the agreement. The current portion of the deferred revenue is $107,300 and is classified accordingly on the balance sheet while the amount included in contract revenue in the current year is $126,248 (1988 - $145,214).

7. Deferred Charges

In accordance with the agreement between the Advanced Technology Training Centre of Saskatchewan and the Council dated October 4, 1985, the Council has provided the Centre funding for certain CAD/CAM equipment purchases in return for specified computer services.

In prior years, the Council paid $367,014 to the Centre of which $45,877 (1988 - $137,631) is classified as deferred charges and is amortized on a straight-line basis over the four year period in which the computer services are to be received.

8. Retroactive Salaries Payable

This amount represents the 1988 merit salary adjustment approved by the Board.

9. Statement of Changes in Financial Position

The net change in non-cash working capital balances related to operations is comprised of the following:

	1989	1988
Decrease (increase) in accounts receivable	$ (341,484)	$ 903,059
Decrease (increase) in prepaid expenses	(4,206)	24,472
Decrease in inventory	138,926	17,711
(Decrease) in research grants payable	(32,648)	(1,871)
Increase (decrease) in accounts payable	1,103,293	(229,320)
Increase (decrease) in employee deductions payable	3,485	1,223
Increase (decrease) in deferred revenue	250,071	(371,320)
(Decrease) in vacation and benefits	(30,529)	(37,570)
Increase (decrease) in retroactive salaries	(160,000)	90,258
	$ 926,908	$ 396,642

10. Related Party Transactions

Related parties to the Council are Saskatchewan's Crown controlled departments, agencies and corporations. Transactions with these parties are recorded at normal market prices except as described below.

During the year, the Council paid $2.1 million to Saskatchewan Property Management Corporation for accommodation charges on buildings. These buildings were provided to the Council by the Saskatchewan Department of Supply and Services at no cost in prior years until April 1, 1987.

11. The comparative financial statements have been reclassified from statements previously presented to conform to the presentation of the March 31, 1989 financial statements.